REPRODUCING THE RIVER: HISTORIC CONTEXT AND RESOURCE SURVEY OF OREGON'S STATE FISH HATCHERY SYSTEM

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March 2018

Title: Reproducing the River: Historic Context and Resource Survey of Oregon's State Fish Hatchery System

Oregon's fish hatchery system developed in the late 1800's in response to salmon fishery losses. Salmon hatcheries consist of a number of built components. 'Growing fish' requires a variety of building types supporting the hatchery process as well as constant input of resources. In addition to surveying and inventorying fish hatchery resources, this study will analyze the social, economic, cultural, and environmental conditions under which these fish hatcheries were organized and commissioned. Ultimately, this survey will not only serve as a baseline for future, more intensive-level surveys, but will also provide a foundation for a National Register Multiple Property Submission. The use of hatcheries to sustain native Oregon fish species constitutes a major aspect of Oregon's fishing and environmental conservation efforts. Oregon's heritage hatcheries stand as physical reminders of early conservation activity and while their preservation provides a more complete picture of Oregon's relationship with natural resources.

INTRODUCTION

The significance of the project lies in the fact that fish hatcheries have been, and in many ways still are, an important component of Oregon's history regarding its residents' relationship with natural resources. Unfortunately, it is a history that is not told nearly as often as more common resource extraction and agriculture counterparts such as traditional farmsteads, mining, or timber.

Specific study of the material structure comprising Oregon's artificial propagation efforts remains isolated at best, largely clouded and wanting. Furthermore, as noteworthy, public resources, the identification, evaluation, and protection of historic fish culture resources is de rigueur. Many fish hatcheries are, or are nearing, fifty years of age; the need for their survey has reached certain imperativeness. Lastly, as the physical sites of propagation, intrinsic hatchery elements convey significance by pulling together often-disparate historic narratives. Addressed, these detached scenes display respective design features specific to Oregon's initial and subsequent periods of hatchery development. Taken together, they express insights into the history of aquaculture as well as evolving approaches of our own relationship with natural resource management in Oregon.

HISTORIC CONTEXT

The destruction of fisheries up through the Civil War provided the impetus for the development of technology to artificially recover fishery conditions. Fishing proved an important component of industrial development in birth of colonial New England.[1] Rapid industrialization diminished fishery stocks nationwide. Instead of restricting catches and improving stream conditions, commercial pressure forced a political response pushing for ways to create more fish— "If you could make more fish, then you did not have to regulate the harvest among competing users."[2] Through technology, the perception of inexhaustible ocean fisheries could become reality.

Oregon's fish hatchery system developed in the late 1800's in response to fishery losses. With improvements in processing and preservation through canning, salmon fishery prominence quickly grew, becoming a considerable component of Oregon's heritage. The newly organized Oregon and Washington Fish Propagation Company built the Columbia River Basin's first recorded hatchery in 1876. Ten years later, the three person Oregon State Board of Fish Commissioners formed and allocated a $1,000 budget to enforce fish and game laws and operate a hatchery for two years. Continued increase in hatcheries can be attributed to the growth of industry and development in the state. After

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[1] Mary Finley, "The Tragedy of Enclosure: Fish, Fisheries Science, and U.S. Foreign Policy, 1920-1960," (PhD. Dissertation: University of California, San Diego, 2007), 29; citing Raymond McFarland, *A History of the New England Fisheries* (New York: University of Pennsylvania, 1911), 19.

[2] Mary Finley, "The Tragedy of Enclosure: Fish, Fisheries Science, and U.S. Foreign Policy, 1920-1960," (PhD. Dissertation: University of California, San Diego, 2007), 30.

1930, growing support for hydroelectric facilities, a significant threat toward native fish species, necessitated the increase in hatchery activity.[3] In 1975, the Fish and Wildlife Commissioners merged under one agency and operating hatcheries numbered 31.4 Today, the Oregon Department of Fish and Wildlife (ODFW) operates 33 hatcheries.

The Species of Concern: Salmon and Trout

To appreciate and describe the challenges and design consideration of a hatching and rearing facility, it is important to understand the lifecycle and natural setting related to the target species. Salmon and trout culture involves a series of methods designed to replicate natural settings and artificially produce juvenile fish that will successfully mature in the open ocean.[5] Just before reaching sexual maturity, these species, collectively termed *salmonids*, begin a long journey to their home stream in order to reproduce.

The challenges in propagating these species has been the focus of decades of fisheries biology research and, as such, is difficult to summarized in this brief introduction. Extensive existing literature describes the natural history, life-history

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[3] Stephen Beckham, *The Bonneville Hatchery: A Historical Assessment for the Bonneville Navigation Lock Project, Bonneville, Oregon*, Eugene: Heritage Research Associates, 1986. Report to Portland District, U.S. Army Corps of Engineers, 6.

[4] "Oregon Department of Fish and Wildlife History, 1792 – 2011," Oregon Department of Fish and Wildlife, last modified June, 2015, accessed December 9, 2016, http://www.dfw.state.or.us/agency/history.asp

[5] Patricia Roppel, *Alaska's Salmon Hatcheries: 1891-1959* (Portland, OR: National Marine Fisheries Service, 1982) 35.

patterns, habitats, and ecology of salmon.[6] On the other hand, prevailing general patterns do exist instruct the challenges and subsequent techniques utilized in salmon culture.

Aquaculture History

The earliest documented husbandry of aquatic organisms traces back to ancient carp farming in the fifth century B.C. in China and potentially as early as 4,000 B.C. Egypt. Romans constructed most likely the first concrete ponds. In Europe, earthen ponds were used to contain carp primarily for symbolic purposes. The practices were carried and refined throughout Europe and the Mediterranean, expanding to new fish and shellfish species. France became a particular epicenter of fish culture during the 19th century.

America's Conservation movement and Early Fish Culture, 1850-1911

Scientific inquiry into aquaculture in the U.S. began in the early nineteenth century—its popularity bolstered by the escalating Conservation Movement. In the midst of the Civil War, the first North American hatchery was constructed under the supervision of Seth Green at Mumford, New York.[7] Green, borrowing the methods

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[6] Thomas Quinn, *The Behavior and Ecology of Pacific Salmon and Trout* (Seattle: University of Washington Press, 2005), ix.

[7] C.G. Atkins, "On the salmon of eastern North America, and its artificial culture," U.S Commission Fish… 1872 and 1873, Part II, Append. B: 226-335 cited in Roy Wahle and R.Z. Smith, "A Historical and Descriptive Account of Pacific Coast Anadromous Salmonid Rearing Facilities and a Summary of Their Releases by Region, 1960-76," *NOAA Technical Report*, National Marine Fisheries Service 736 (Washington, D.C.: U.S. Government Printing Office, September 1979).

discovered in Europe a century earlier, engaged in commercial fish culture—a burgeoning industry. After the war's end, New York State established its first State Fish commission, appointing Green as one of its commissioners. The use of fish culture to supplement and even replace stocks of declining or extinct New England fisheries seemed a reality.[8]

By the 1860's, approximately thirty private hatcheries, in addition to publically established fish commissions, worked to advance fish culture methods. The American fish-culture movement, beginning in the New England states, profoundly altered the social landscape in regards to the public's approach to conservation. Fish culture influenced resource management two ways: fishery losses provided evidence of industrialization and over-fishing while the technological advancements afforded by aquaculture promised an improved, limitless fishery that would allow growth to continue unrestricted.

Oregon Salmon Culture History

The expanding and deepening role of U.S. Fish Commission hatcheries spread west, first to California and then, in an advisory capacity, to Oregon in 1875. Although Atlantic salmon existed in limited numbers enough to supply New England propagation

[8] Robert Stickney, "History and Purpose of Fish Culture," in *Fish Hatchery Management*, 2nd ed. Gary Wedemeyer, editor (Bethesda: American Fisheries Society, 2011), 1-30.

efforts, abundant west coast salmon, capable of tolerating warmer waters as compared to Atlantic species, offered a promising outlook for success in restocking East Coast rivers.[9]

Salmon Industry in Oregon

The unassuming tin can transformed the salmon industry and the Pacific Northwest. With continued improvements in canning technology and successful marketing, mass-production intensified. Initial canning of salmon canning occurred along the Sacramento River in California by the firm of Hapgood, Hume and Company.[10] Over two decades, fueled by marketing and technological improvements, the industry flourished. Production marched north from the Sacramento River in California to the Columbia River, Puget Sound, and on to Alaska; "few industries have undergone such a rapid shift in the center of activity."[11] The industry's propensity for over-production depleted natural salmon runs and significantly influenced "regional population and labor structures."[12]

At the heart of the Columbia salmon canning industry was faith in the natural

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[9] Dean C. Allard, Jr., *Spencer Fullerton Baird and the U. S. Fish Commission: A Study in the History of American Science* (New York: Arno Press, 1978) 138.

[10] Clark Spurlock, "A History of Salmon Industry in the Pacific Northwest" (Master's thesis, University of Oregon, 1940) 116. Difficulties in their first two season moved the company to seek out a new location, settling on a site at Eagle Cliff, Washington. For more on Hapgood, Hume and Company see R. D. Hume, Salmon of the Pacific Coast.

[11] Spurlock, 187.

[12] Spurlock, 187.

patterns of migratory salmon returns. The overwhelming number of salmon appeared never-ending. Often, canners could not keep up with the supply of caught fish. Unfortunately, canneries would quickly become the victims of their own success.

U.S. Federal Involvement

In 1866, Stone commenced a survey of the Columbia to locate an appropriate site for the future hatchery. With little knowledge of the distinct species of salmon and little regard for settlements upstream, he decided on a site along the Clackamas River near its confluence with the Columbia River. The hatchery began operations in 1877 and after ten years the State of Oregon took an active role in the development of salmon hatcheries through the establishment of its own hatcheries through the authorization of the of Board of Fish Commissioners in 1887. A year later, in 1889, operation of the hatchery transferred to the U.S. Commission of Fish and Fisheries under the condition that eggs and fry remain in Oregon.

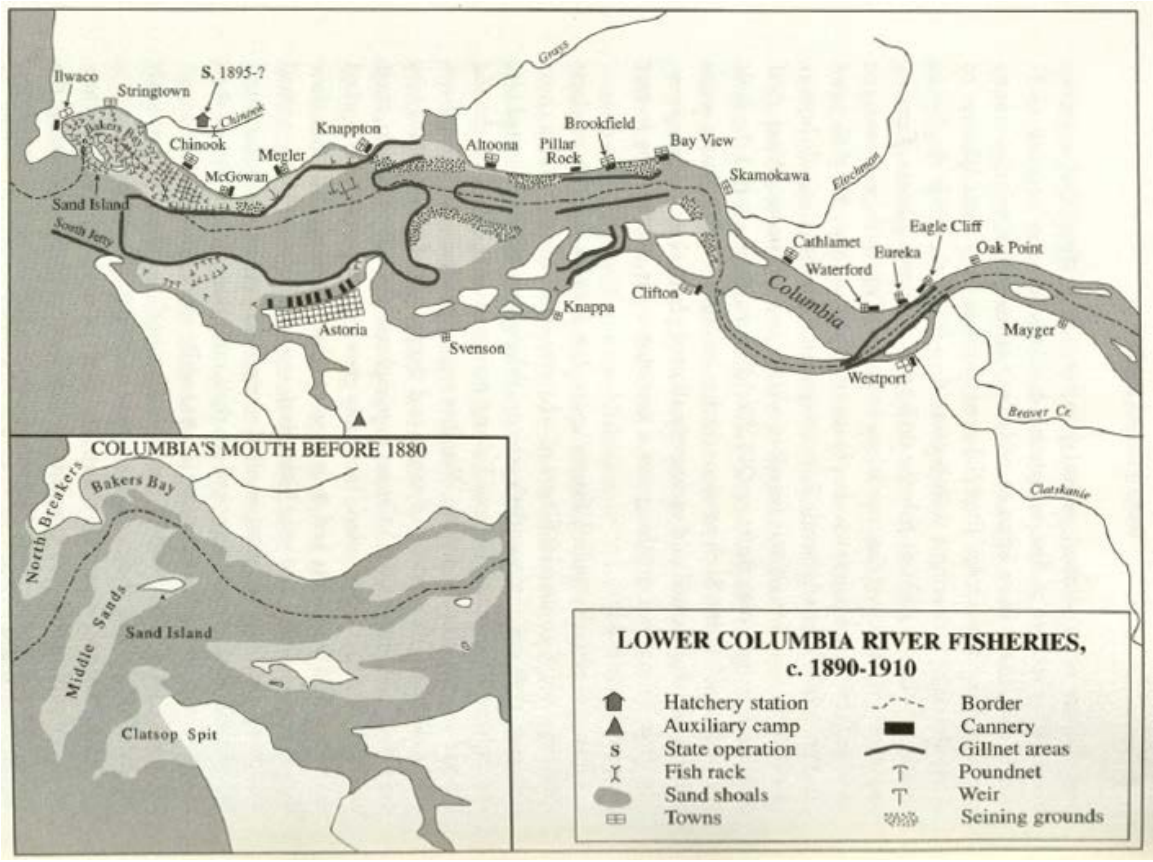

Figure 2.1. Location of hatcheries in relation to Oregon's salmon industry activity. Courtesy of Joseph Taylor, *Making Salmon: An Environmental History of the Northwest Fisheries Crisis* (Seattle: University of Washington Press, 1999), 143.

Oregon Coast

The first hatchery along the Oregon Coast was constructed by R. D. Hume in 1877 on the Rogue River. Hume, whose commercial efforts included the entire production cycle from rearing to canning, was able to gain public support for his private

endeavors. Oregon Legislature supported Hume's hatchery through public appropriations to use for enlargement, operation and maintenance.[13]

Hume's vertically integrated system included early attempts at hatchery development in addition to harvesting and canning operations. Hume experimented with egg collection at various sites along the Rouge River in addition to various hatchery methods and rearing locations. Eventually Hume partnered with the State and the sites of his early exploits served as State-run hatcheries in later years.

Historians credit Hume with originating the concept of adult holding ponds. Adult holding ponds allowed Hume to hold returning adults until they "ripened"—reaching sexual maturity—and egg or milk taking could occur.[14] Adult holding areas have gained prominence in contemporary hatcheries.

Another example of Hume's unconventionality: while most hatchery operators were eager to release fry shortly after absorbing their yolk sac, Hume practiced rearing fish for longer periods and releasing more mature fingerlings.

Outside of Hume's hatcheries, the State directed construction of hatcheries and egg taking stations on most of Oregon's coastal rivers. In addition to the challenges of early fish culture methods, these coastal hatcheries continually struggled against

[13] Roy Wahle and R.Z. Smith, 1979.

[14] Roy Wahle and R.Z. Smith, 1979.

commercial anglers whose nets cutoff returning salmon from the upstream hatchery locations.

State Involvement, 1911-1929

In 1911, the State's interest in natural resource management expanded by forming a combined State Board of Game and Fish Commissioners. In addition to game birds and animals, this new board also introduced the idea of trout hatcheries that, up until this point, had been pushed aside in favor of efforts solely focused on salmon. This move represented the increasing pressure by sport anglers on the State.

War Era Mitigation, 1920-1949

As the Oregon Fish and Game Commission matured and propagation techniques improved the survivability of stocked fish, hatchery development entered a new era of growth. In 1920 alone, six new hatchery facilities were constructed. The automobile, technological leaps, and post-World War I economic growth pushed the hatcheries to the brink in order to meet demand. World War II also brought its own unique challenges and opportunities, creating lasting impacts on the built fabric within Oregon's hatchery system.

The Automobile and Outdoor Leisure: 1920-1930

Initially, Oregon's immense size and challenging topography provided significant barriers to developing highways and rural road networks. An influx of new residents and

resources in the 1920's provided the means to new rural connections and offered an alternative to rail transportation.

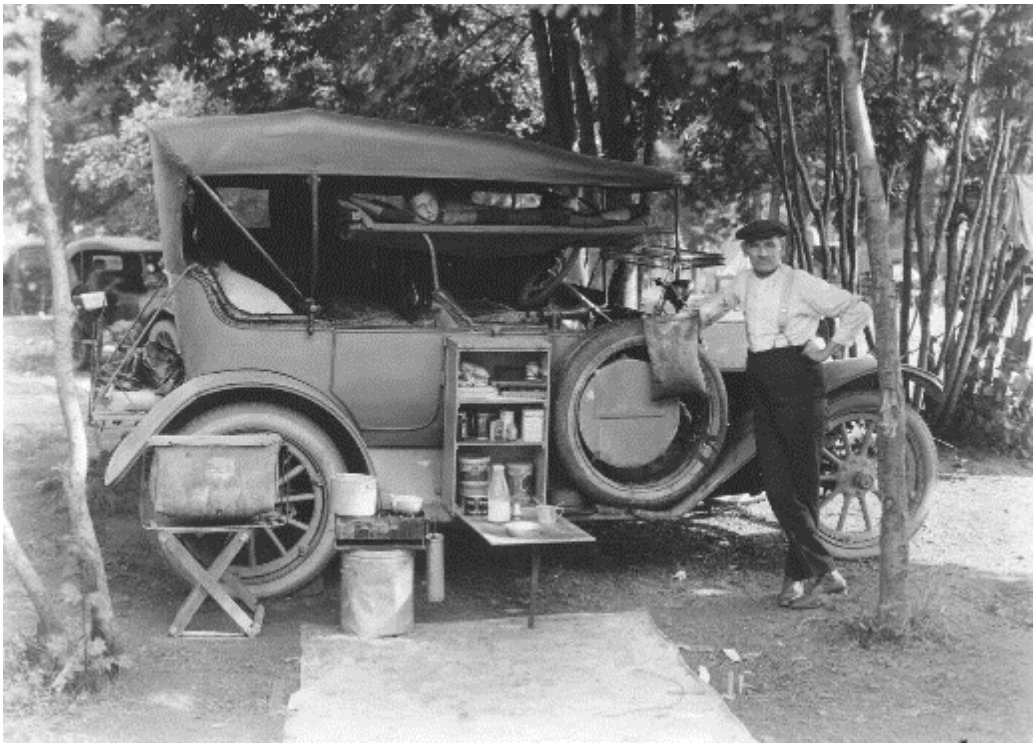

Figure 2.2: A child and man pose with an automobile equipped with camping equipment, c. 1925. Courtesy of Angelus Studio photographs, 1880s-1940s, University of Oregon, Special Collections and University Archives, Eugene, Oregon.

Scientific Discipline

As hatchery activity expanded in response to new pressures for their yield, culturists experimented with new programs and methods for increasing hatchery output. Coinciding with this expansion, "many scientific disciplines that underpin aquaculture

began to mature."[15] Fish culturists became increasingly interested in regulating the environmental conditions of the ponds as hatcheries reared both trout and salmon for longer periods and to larger size before releasing the fry. Chemists and biologists conducted studies to understand and refine water quality control and disease prevention. During this period educational programs also gained in support and popularity. Oregon State established its Department of Fish, Game, and Fur Animal Management in 1935 and at the same time legislation established the Oregon Cooperative Wildlife Research Unit.[16]

A significant leap forward in standardizing and communicating improved culture techniques arrived in the form of a new, professional journal. In 1934, "recognizing the need for placing before hatchery men in a simple understandable form recent advances in the art and science of aquaculture," the US Bureau of Fisheries began publishing *The Progressive Fish Culturist*. The publication provided concise summaries and views regarding pressing issues facing fish culturists with special consideration for fish disease, feeding, record keeping, and best practices. Much of the need for developments stemmed from the practice of holding and rearing fish to more mature, larger life stages thus exposing trout and salmon to greater instances of affliction and fish loss.[17]

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[15] Robert R. Stickney, Aquaculture in the United States: A Historical Survey (New York: John Wiley & Sons, 1996), 121.

[16] "About Us," Oregon State University, College of Agricultural Sciences, Department of Fisheries and Wildlife (oregonstate.edu/fisheries-and-wildlife, accessed Jan, 2018).

[17] Elmer Higgins, "Prospectus," *The Progressive Fish Culturist* I-131, no. 1 (Washington, D. C.: Bureau of Fisheries, December 1935): 1.

Hydroelectric Dams Mitigation

Despite initial success in producing surviving trout and salmon, artificial propagation failed to allay the concerns of State officials and sportsmen. Among others, the reliability of hatcheries to produce large-scale returns remained unproved. In 1936, regarding losses on the Klamath, for example, investigations indicated that artificial propagation was insufficient and that greater restrictions on the fishing season provided the only improvement in seasonal runs of salmon and steelhead.[18]

In the mid-1930s, however, the Columbia River Basin, and the Pacific Northwest by extension, entered a new era of industrialization. In 1937, the Army Corps of Engineers completed construction of the Bonneville Dam and Congress created the Bonneville Power Administration to coordinate and supervise regional, wholesale electric distribution.[19] A New Deal project of the Roosevelt administration, the dam's completion represented a significant first step towards a new hydroelectric power policy for the Pacific Northwest—the Columbia Basin Project.[20]

The mitigation for losses to native fisheries caused by hydropower, flood control, and irrigation benefits of dams increased hatchery supplementation. Hatcheries gained

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[18] California Conservationist in "News Notes and News," *The Progressive Fish Culturist* I-131, no. 18 (Washington, D. C.: Bureau of Fisheries, May 1936): 14.

[19] Sarah T. Phillips, This Land, This Nation: Conservation, Rural America, and the New Deal (Cambridge: Cambridge University Press, 2007), 235.

[20] Philip Funigiello, *Toward a National Power Policy: The New Deal and the Electric Industry, 1933-1941* (Pittsburgh: University of Pittsburg Press, 1973), 174.

new significance.[21] Dam builders could employ hatcheries to offset any suggestion of harm to native fish runs. When, in 1937 Congress enacted the Bonneville Project Act, the Commissioner of Fisheries suggested the use of "adaptive management" approach, federal influence renewed the call for investment to fish-culture. Congress responded, enacting the Mitchell Act in 1938. The Mitchell Act authorized funding for salmon recuperation through hatcheries fish ladders, irrigation screens, habitat restoration, and scientific studies. However, with a limit of $500,000, action was limited to watershed surveys.[22]

[21] Michael Blumm, *Sacrificing the Salmon: A Legal and Policy History of the Decline of Columba Basin Salmon* (Lake Mary: Vandeplas, 2002),111-112. Another excellent resource on the history of Columbia River development is Richard White's, The Organic Machine: The Remaking of the Columbia River (New York: Hill and Wang, 1995).

[22] Blumm, 112.

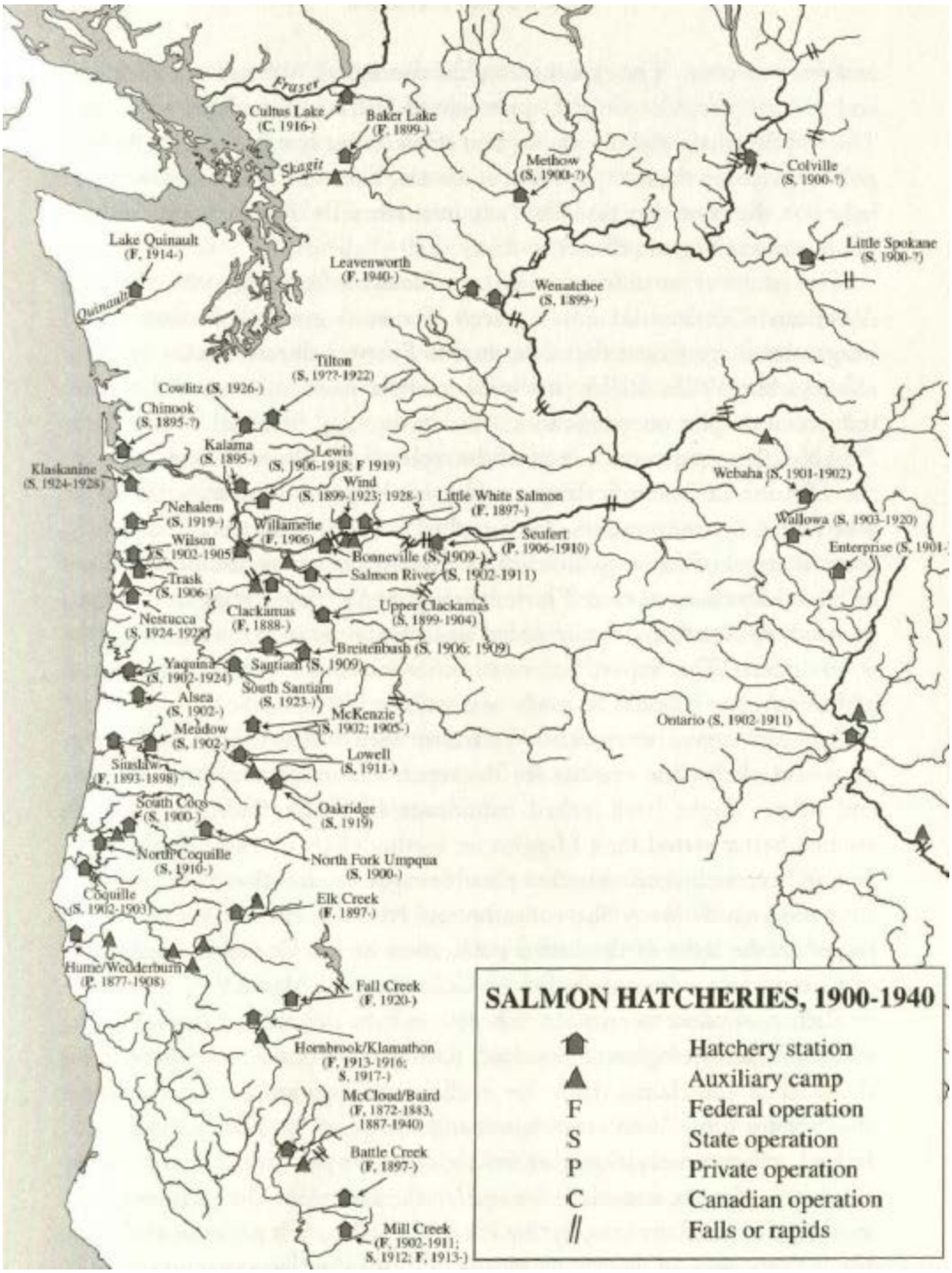

Figure 2.3. Map of early-20th century salmon hatcheries in Oregon and Washington. Courtesy of Joseph Taylor, *Making Salmon* (Seattle: University of Washington Press, 1999), 223.

Contemporary Development, 1949-2018

At the conclusion of World War II, the U.S. entered into period of postwar economic growth and prosperity. Congress followed up the construction of Bonneville and Grand Coulee dams with the Rivers and Harbors Act of 1945 authorizing new dams in the Columbia River Basin, particularly around the Lower Snake River. Dam construction transformed the Columbia River into a series of impoundments. The inundation of spawning habitat immediately restricted natural salmon production, particularly for fall chinook and summer steelhead while all species have been severely impacted by juvenile mortality and loss of returning adults due to the dams.[23]

After World War II, applied science, it is safe to assume, quickly advanced fish hatchery operations. Such advances include the use of new chemicals in preventing disease, improvements in spawning, and introductions of "labor-saving devices such as fish loaders, self-graders, incubators," as well as progress in dry feed.[24] Regarding the evolution of fish culture after the second world war, the *Textbook of Fish Culture* (1970) calls out two compelling developments which apply to the changing form Oregon's salmon and trout culture: modern forms of transportation for fish and developments in the use of artificial food based on concentrates.[25] The ability to more easily transport fish in

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[23] Washington Department of Fishereis and ODFW, *Columbia River Subbasin: Salmon and Steelhead Production Plan* (Northwest Power Planning Council and Columbia Basin Fish and Wildlife Authority, September 1989) 11.

[24] Earl Leitritz, 7.

[25] Marcel Huet, *Textbook of Fish Culture: Breeding and Cultivation of Fish* (Surrey, England: Fishing News, Ltd., 1972), 3.

various life stages—from fertilized egg to full grown—resulted in expanded stocking as well as inter-hatchery systemization. Pelleted food eliminated the need for cold storage and onsite food processing while also allowing for greater control of fish health and growth. Overall, changes after 1950 resulted in even more standardization and consolidation within Oregon's hatchery system.

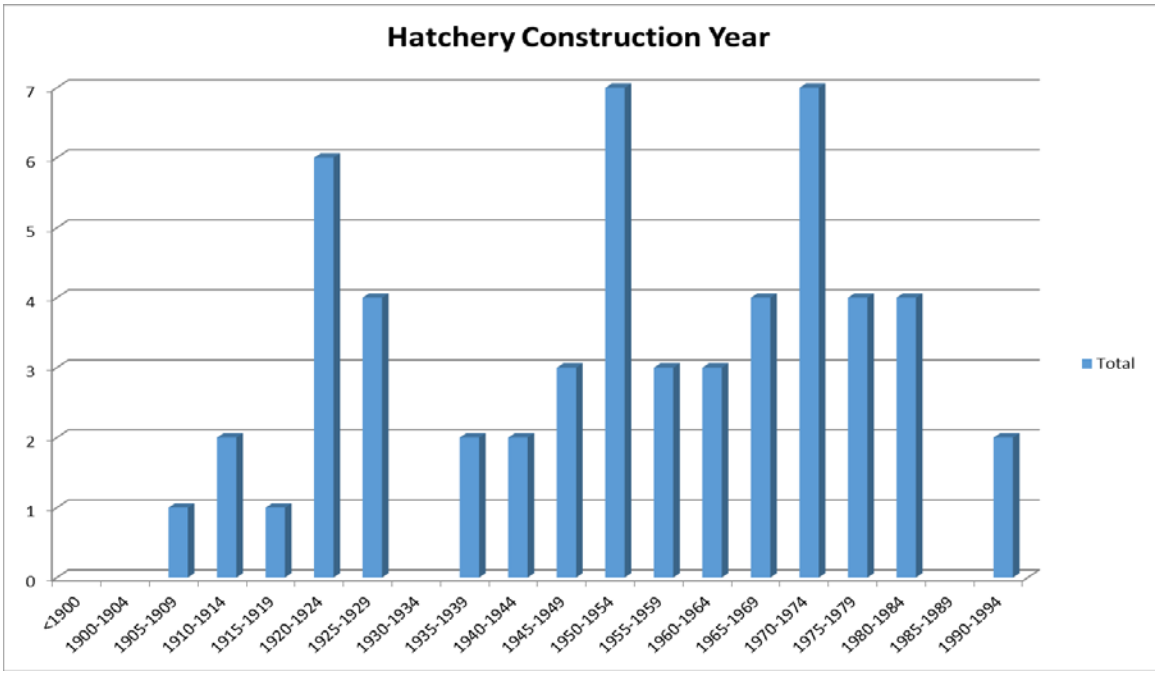

Table 2.1. Total number of hatcheries constructed by 5-year increments.

Hatchery Components

Hatcheries consist of a number of built components. Similar to a traditional farmstead, 'growing fish' requires a variety of building types which support the hatchery process, housing for crew members, as well as access to a constant input of resources which mean proximity to transportation in addition to appropriate natural resources.

Individual structures are difficult to separate from the larger complex as their relationships' are so intertwined.

Egg Taking

Egg collection generally occurred at remote locations, which met the particular criteria favored by spawning salmon while also facilitating the workers' ability to catch the spawning fish. Usually areas near the confluence of two streams with pools and shallow riffles.

The construction of "spawn-taking" facilities developed more recently in regards to hatchery design with fish being "herded into the spawning enclosure without being taken from the water."[26] Regardless of whether the spawning house was constructed over enclosed ponds or not, the structure would include furnishings for sorting, stripping, and artificially fertilizing the eggs.

Hatchery Site Selection

According to the American Fisheries Society, "fish culture consists of a group of methods intended to fulfill the life cycle requirements of the fish in order to produce the species, number and size desired." Of the requirements, water is of upmost importance, "it is indeed to a hatchery what coal is to a steam-engine, all hatching apparatus of

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[26] Earl Leitritz, *Trout and Salmon Culture: Hatchery Methods* (Fish Bulletin No. 107), State of California, Department of Fish and Game, June 1959, pp 24.

whatever kind being merely mechanical devices for extracting and transferring from it the greatest amount of energy to the ova."[27] Early hatcheries generally relied on streams for water while later designs, recognizing the susceptibility of streams to disease and other forms of contamination, located near natural springs and wells.[28]

Figure 2.4. Hatchery site including a 'rack' for collecting salmon, the hatchery building with troughs, and a train bridge in the background. The only identifying information locates this scene in Wallowa County c. 1910. Courtesy Oregon Historical Society Research Library, OrHi 3499, Lot 790, Box 19, Folder 14.

[27] James G. Maitland, "The Culture of Salmonidae and the Acclimatization of Freshwater Fish," *The Fisheries Exhibition Literature*, Vol 6, International Fisheries Exhibition, London, 1883 (London: William Clowes and Sons, 1884): 33-68; J. T. Bowen, "A History of Fish Culture as Related to the Development of Fishery Programs," in *A Century of Fisheries in North America*, Edited by Norman Benson (Washington, D.C.: American Fisheries Society, 1970) 74-76.

[28] Earl Leitritz, *Trout and Salmon Culture: Hatchery Methods* (Fish Bulletin No. 107), State of California, Department of Fish and Game, June 1959, pp 11.

Hatchery Building

Incubation, hatching, and preliminary rearing—the decisive affair of the entire operation—resides in the hatchery building, also referred to as the hatch house or incubation building. To accommodate the work of incubating and rearing small fingerlings, hatchery building design needed to provide large, open labor and storage spaces for work-related clothing and equipment.

The earliest hatchery buildings in Oregon did not share the permanence and dignity of New England buildings. Hatchery buildings were often open air structures with gable roof, built for seasonal use (Figure 2.6).

As hatching operations moved to include longer periods of rearing, year-round care for the young fish necessitated permanent structures. Hatchery buildings included areas for gear storage, a large room for troughs, and usually an area for record keeping, such as an office.

Figure 2.5. Unidentified salmon hatchery building and wood flume c. 1910. Courtesy Oregon Historical Society Research Library, OrHi 3499, Lot 790, Box 19, Folder 14.

Water Transport Structures

Reliably transporting water from intake areas to the hatchery buildings, ponds, and off-site requires the use of water transport structures. Hatcheries exhibit a myriad of design and material trends over periods of development. The various combinations coalesce into four major groups: open canals, aqueducts, pipelines, and siphons.29 Most commonly encountered, however, are open water canals and pipelines, both of which generally rely on gravity to move the water as opposed to pumps or siphons.

Ponds

Rearing ponds serve to take the place of small streams where, in their natural lifecycle, juvenile fish would have matured to the point where they could migrate downstream and eventually to the ocean. The physical and physiological environments provided by rearing ponds significantly affect survival rates and, as such, the success of fish culture operations.[30] Years of trial and error research in addition to the variable conditions of hatchery sites and specific needs of individual species resulted in an abundance of pond designs.

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[29] Food and Agriculture Organization of the United State, *Simple Methods for Aquaculture—Pond Construction for Freshwater Fish Culture: Pond-farm structures and layouts* 20/2, by A.G Coche, (Rome, FAO, 1992) 35-36.

[30] Roger Burrows and H. Chenoweth, "The Rectangular Circulating Rearing Pond," *The Progressive Fish Culturist* 32, no. 2 (April, 1970): 67.

Figure 2.6. Wood-lined, earthen rearing ponds at Millcreek Hatchery, Salt Lake County, Utah c. 1890. Courtesy George M. Ottinger photograph collection, P0123, Special Collections and Archives, University of Utah, J. Willard Marriott Library, Salt Lake City, Utah.

Rearing ponds generally fall into two broad design categories—circular or raceways ponds. The design decision depends largely on environmental setting of the hatchery—largely water source variables. Species type and rearing strategies also influence pond design. Ultimately, ponds should provide space for fish to grow, the constant water flow allowing for the recycling of fresh water while flushing detritus, and ease in grading and capturing fish for transporting.

Outbuildings

Fish hatchery stations will often include an assortment of various outbuildings. As with most outbuildings, each "purpose-built structure" is designed for a single task.[31] For example, single uses might include automobile repair, feed storage, spawning, or housing water-pumping apparatus.

Storing and preparing food presented a serious hurdle to early hatcheries. Identifying timing, amount of feeds, and type of constituted a significant portion of hatchery research work. Breakthroughs generally resulted from trial and error as no standard existed during the 19th and early 20th centuries. Access to quality food supplies further complicated feeding of fry.[32] Feeding fish at the hatchery composed a significant portion of the hatchery budget, and as such, securing low-cost, stable food supplies proved a serious concern.

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[31] Michael Olmert, *Kitchens, Smokehouses, and Privies* (Ithaca: Cornell, 2009), 3.

[32] Patricia Roppel, *Alaska's Salmon Hatcheries: 1891-1959* (Portland, OR: National Marine Fisheries Service, 1982) 53-55.

A 1935 survey of hatchery foods and feeding practices conducted by the U.S. Bureau of Fisheries provides insight into the attitude of fish culturists during the initial period of hatchery expansion in response to federal dam projects. The impetus for the study, nationwide rising costs of "packing-house products," was "brought forcibly to the attention of the State and Federal fish hatchery operators."[33] The survey of State, Federal, and private hatcheries found that in 1934, hatcheries consumed 11,455,000 pounds of food consisting of meat, fish, diary, and plant products.[34] Food sources were usually combined to influence the greatest growth of the hatchery fish. Suppliers shipped the feed in fresh, frozen, dehydrated or canned forms.

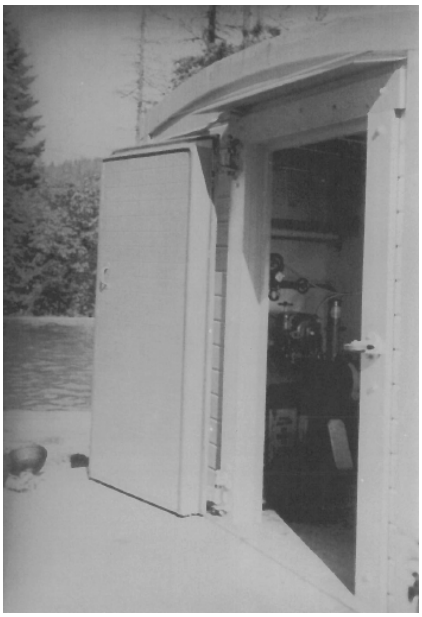


Figure 2.7. Cold storage building with insulated door c. 1935. Courtesy Oregon Historical Society Research Library, OrHi 3499, Lot 790, Box 19, Folder 5.

Feeding practices manifest in the physical design of hatcheries and in their administration and systematic organization. For instance, the 1935 survey

[33] R.H. Fiedler and V.J. Samson, "Survey of Fish Hatchery Foods and Feeding Practices," *Transactions of the American Fisheries Society*, (Washington, D. C., 1935): 377-398.

[34] R.H. Fiedler and V.J. Samson, "Survey of Fish Hatchery Foods and Feeding Practices," *Transactions of the American Fisheries Society*, (Washington, D. C., 1935): 377-398.

Figure 2.8. Meat grinder used in preparing feed for juvenile salmon, Oakridge Salmon Hatchery (Willamette Hatchery) c. 1955. Courtesy Oregon Historical Society Research Library, OrHi 3499, Lot 790, Box 14, Folder 17.

report found that hatchery operators rarely stored significant quantities of feed, instead opting to purchase feed as needed. The lack of large, on-site storage or central cold storage necessitated reliable access and transportation. Furthermore, the lack of coordination decreased the collective bargaining and the potential for lower costs tied to economies of scale.

Residences

Hatchery operation require around-the-clock supervision to ensure a quick response should a blockage to the water supply or any number of other emergencies occur. Furthermore, the fish require daily feeding, frequent check-ups and testing, as well as maintenance of machinery and the facility in general. To accommodate this need for on-site staff, hatchery design generally includes residential units. The earliest hatcheries were either located in close enough proximity to developed areas as to not require

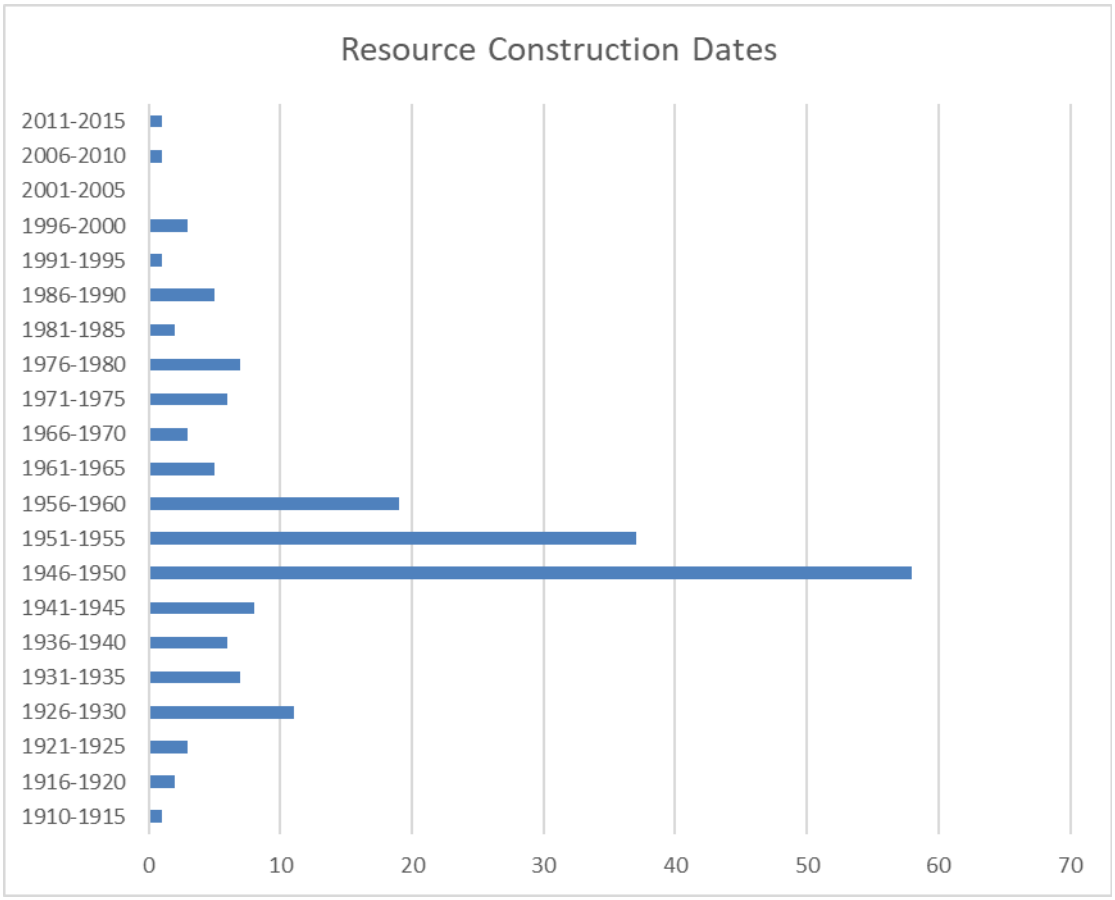
housing. Otherwise, canvas tents and easily transportable housing were used. The need for on-site staff also reflects the evolving approach to rearing trout for longer periods, thus requiring the need for intermittent feeding as opposed to releasing fry upon absorption of their yolk-sac.

FINDINGS

The entire survey effort resulted in the recordation of one-hundred eighty-two resources. Assuming correct, nearby approximation when actual construction date could not be confirmed though primary or secondary source document—the average year of construction across all surveyed hatcheries is 1953, with the earlies construction date recorded in 1911. The survey results suggest that, overwhelmingly and despite initial construction date, today's hatcheries are a product of post-World War II expansion and renovations. Furthermore, the survey highlights the rarity of construction associated with the early era of hatchery construction and propagation activity.

In regards to historic significance, this preliminary survey suggests that the majority of resources, despite later construction compared to the recorded establishment of each station, retain high levels of integrity. One-hundred thirty-two resources were recorded as "Eligible/Contributing" indicting historic significance as part of a larger district or multiple property document. Three resources, two hatchery buildings and one cold storage building, displayed potential significance and integrity as to stand alone and individually listed resources.

Table 2. Total number of resources constructed in surveyed hatcheries by 5-year increments.



Any resource from the initial decades of hatchery development, from the turn of the 19th century through 1919, particularly those associated directly with the propagation process should be considered individually significant due to the rarity and importance within the hatchery system. Pre-World War II resources also share, to a lesser extent, greater potential for individual significance.

Discussion

The historic resource surveys expose common narratives, which, consequently, highlight themes related to specific periods of construction and larger shifts in broader fishery management. Frequent occurrences of prefabricated construction methods and materials in both new construction and substantial facility renovations supports themes related to government mobilization programs. Secondly, unnatural materials which gained in popularity as a result of the war effort as well as increasingly sterilized facility grounds between rearing ponds, hatchery buildings, and outbuildings also indicates a shifting approach to resource management—an approach that is highly science-based, removed, and reliant on grey infrastructure engineering. Lastly, the wide extent of alterations, particularly to staff housing, ties together both the temporary-construction motif and the distinction afforded to the hatchery building as the core component of the model hatchery station. Ultimately, economic growth and the unleashing of new technologies and expanded infrastructures, primarily road building, hydroelectric power grid, and flood control, ushered in the need for a level of management that parallels and interrelates with the 1940's war effort.

Progression of Salmon Culture

Based on periods of increased construction, historical contexts, and broad aquaculture trends, three periods of salmon culture in Oregon emerge.

Initial Hatchery System Development: 1876-1919

Physical evidence of this initial era of fish culture development appears limited. Construction during this period indicates a temporary nature of fish culture activities. Historic resources present on or near the site associated with the initial construction date display dates reflecting subsequent eras of hatchery system expansion. However, the siting of facilities demonstrates reliance on rail transportation and relative proximity to population centers.

War Era Construction: 1920-1949

With the end of World War I and the advent of the automobile, Oregon's hatcheries received a boost of support resulting in improvements to existing facilities and massive expansion of the State's hatchery system. During the 1930's hatchery operations focused on perfecting hatchery efficiency and effectiveness. A scientific approach to record keeping, promoted nationwide by the growing American Fisheries Society, manifested in hatchery design through militaristic, sterile facility layout and landscape. Hatchery construction experienced a brief lull during America's entrance into World War II after which renewed interest in mitigating losses associated with public works projects injected nearly unlimited federal funding.

Contemporary Expansion

The post-war hatchery system build-up mirrored more than military's expansion. Forty years later, climbing maintenance costs called into question the future of 1940s

construction— “it became clear to military planners that the army of the 1980s could no longer be housed either comfortably or inexpensively in 1940s army barracks.”[35] In response, under authority granted by the U.S. Senate, the military began the massive effort of “disposing” of its World War II buildings. With similar, much slower, resolve, ODFW continues to significantly modify or outright replace its post-war, temporary buildings.

CONCLUSION

Aquaculture is a chain events aimed at the rational control of fish production. The central occurrence of transformation of energy and raw materials coalesces within the hatchery building and surfaces in the rearing ponds. As such, the critical element of a hatchery are its hatchery units, particularly the hatch house and rearing ponds. Contributing resources of the hatchery include worker housing, outbuildings, and landscape elements.

The hatchery is built around a system of water, diverted from its source, into the hatching troughs, through rearing ponds, and eventually, what’s not lost in the process, returns to the watershed. Housing a large portion of this process is the hatchery building. The permanence of the hatchery building confirms its distinction above other hatchery

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[35] Diane Wasch, et. Al., *World War II and The U.S. Army Mobilization Program: A History of 700 and 800 Series Cantonment Construction*, Aelene Kriv, Ed. (National Park Service; HABS/HAER, n.d.) 3.

components. Consequently, intakes and water supply systems directly relate to the hatchery building. However, due to their purpose and demanding conditions, intakes appear frequently altered and improved while the hatchery building remains. The prefabricated design and low-cost construction associated with residences and outbuildings further confirms their auxiliary role within the hatchery.

The history of trout and salmon culture architecture, particularly before standardization and mass expansion after World War II, presents a synthesis of stages building on to the previous stage's refinement and a case of necessity where materials were pulled from availability. The construction was a specific response to a specific condition but widely-shared patterns are repeated throughout Oregon's hatcheries suggesting a sort of standardization more commonly associated with government officialdom. Almost, despite the incredibly unique landscapes inhabited by each facility is an essential attempt to control regional landscapes.

Future Research

As research and writing typically do, more questions were raised during this process than answered. Future studies should consider more in-depth histories of individual hatchery stations. Further research could also highlight commonly overlooked characters, most likely associated with local hunting and angling clubs, and their role in the expansion and siting of hatchery stations. Maintaining and preserving historic resources worthy of additional care will also pose a real challenge to the Oregon Department of Fish and Wildlife. Most useful would be a project to gauge feasibility of

an updated condition survey, preservation plan, and training regarding preserving historic resources. Along those lines, there is potential that smaller hatchery sites may be closed in the future. A project to investigate past attempts to reuse these sites and challenges and opportunities to preserve decommissioned sites may identify means to preserve historic fish culture resources.

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